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Experimental Nuclear (Astro)Physics

Ugent:

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SCK°CEN: fission measurements

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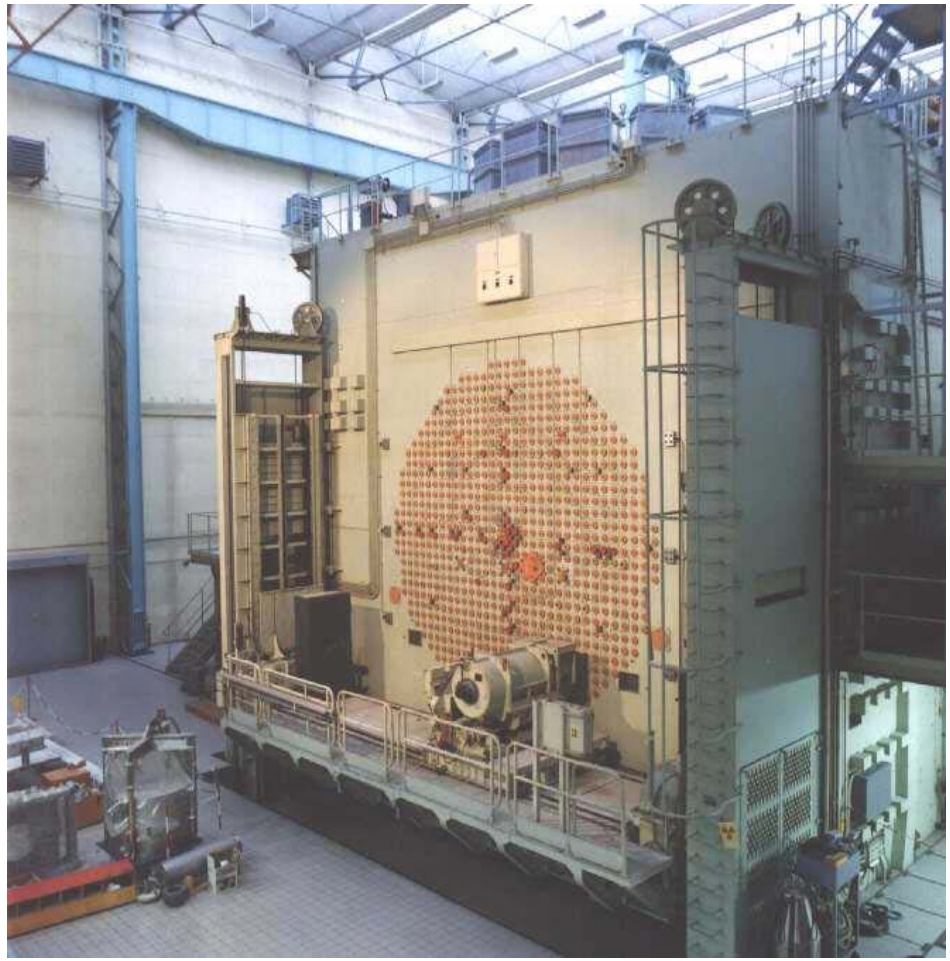
Main experimental facilities used:

GELINA neutron facility Geel
E : 0.01 eV – 2 MeV

HFR Reactor Grenoble
Thermal and cold neutrons

BR1: general description

- research reactor
- nat. U - graphite – gas
- in operation since 1956
- 4 MW thermal power
- operation:
  - daily basis (7h/day)
  - 700 kW



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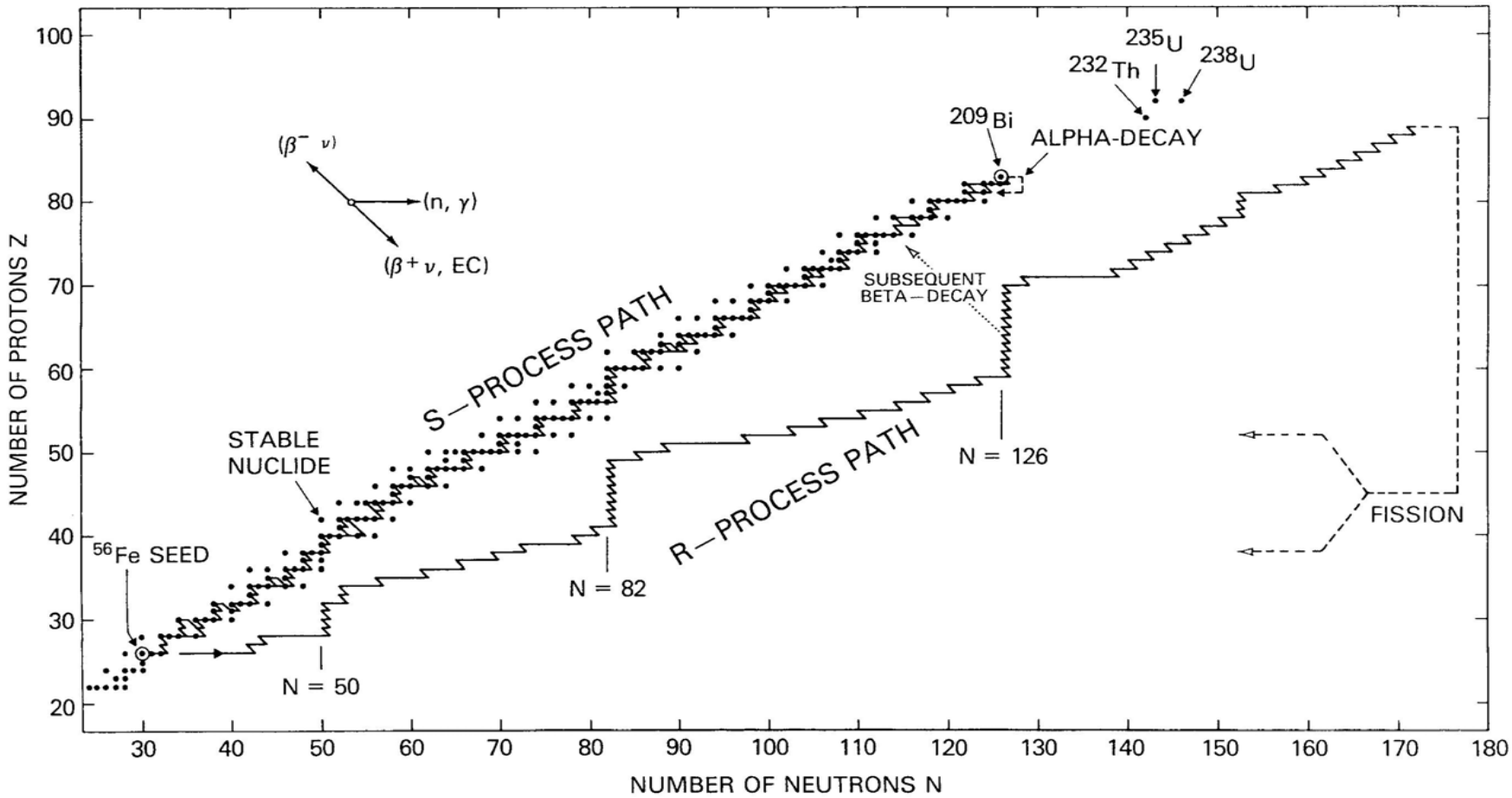
Neutron induced nucleosynthesis paths



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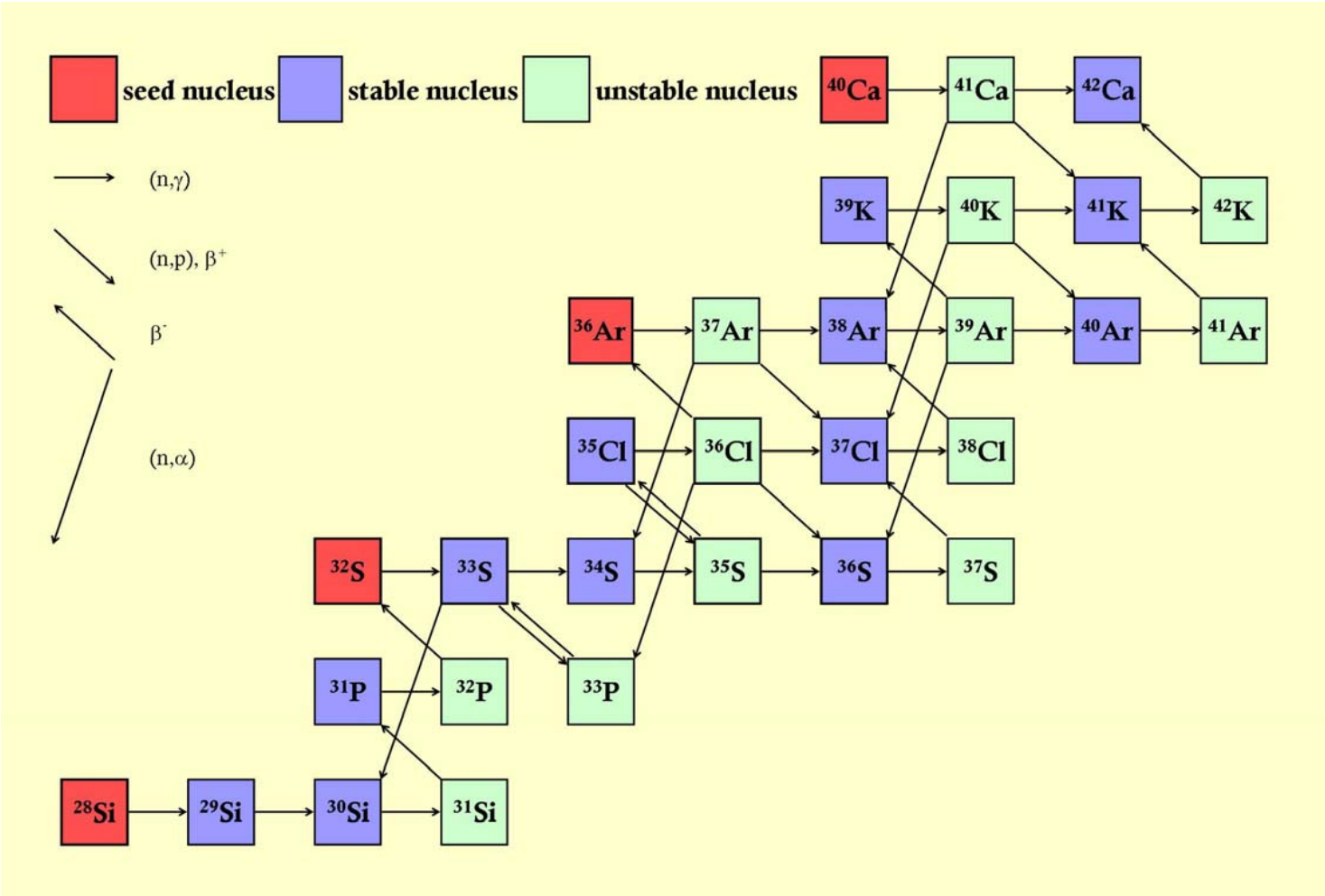
(n,p) and (n,α) measurements: astrophysical context



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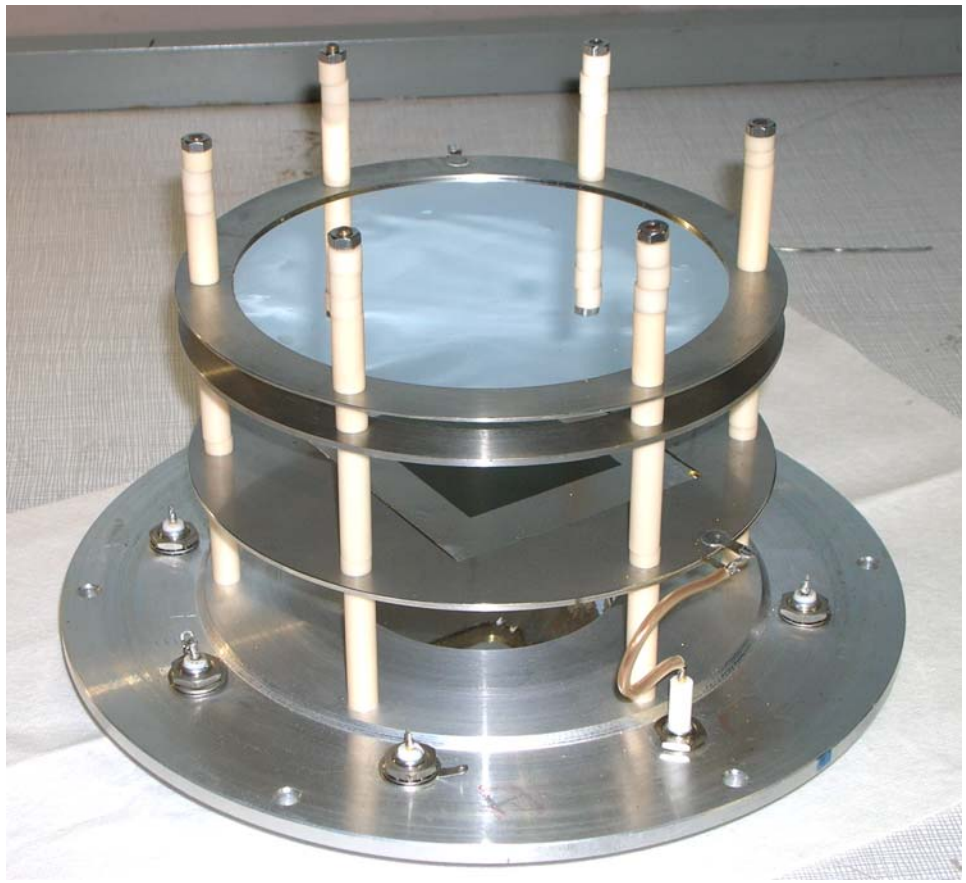
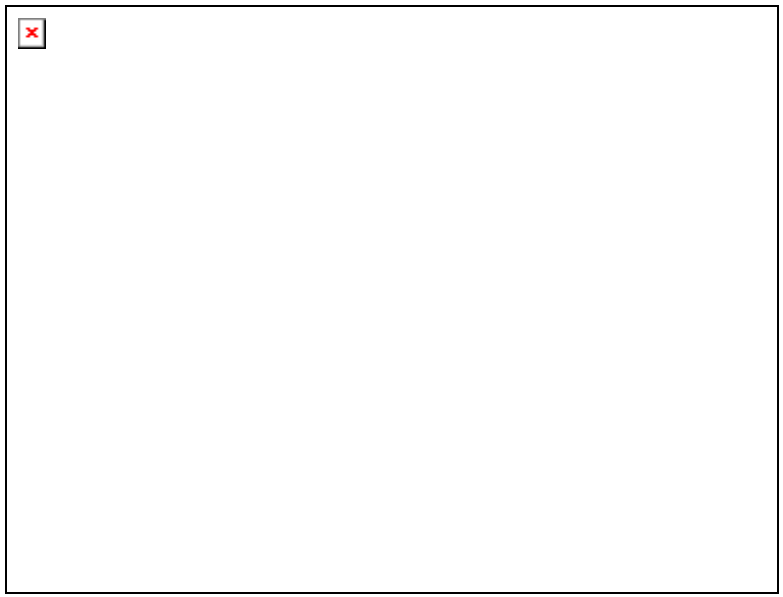
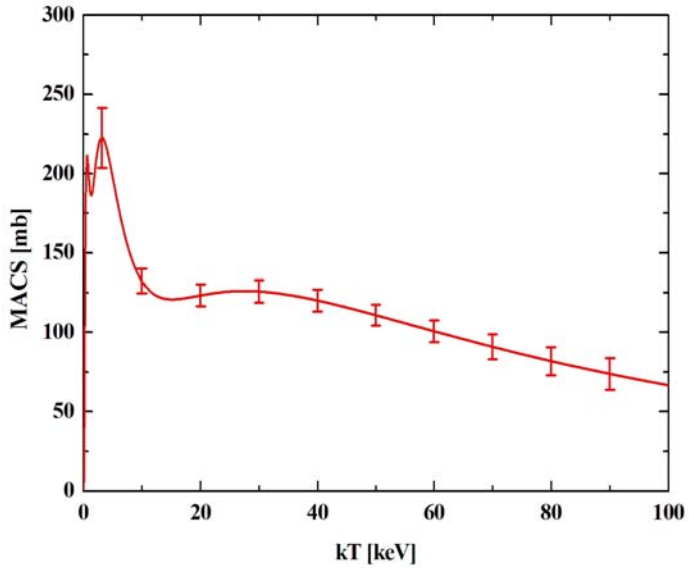
Frisch-gridded ionisation chamber



(n,p) and (n,α) measurements: typical results





^{36}Cl(n,x) cross section

Maxwellian averaged cross section
→ Stellar reaction rates

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(n,p) and (n,α) measurements: perspectives

$^{26}Al(n,p)^{26}Mg$

$^{40}K(n,p)^{40}Ar$

$^{40}K(n,\alpha)^{38}Ar$

$^{41}Ca(n,p)^{41}K$

$^{41}Ca(n,\alpha)^{37}Cl$

Comparison of $\langle\sigma_\alpha\rangle_{exp}$ with $\langle\sigma_\alpha\rangle_{calc}$

→ information on **V_α** and **S_α**

→ to be discussed with P. Descouvemont et al. (ULB)

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Nuclear fission

Fission cross section measurements:

- **end of r-process**

- **transmutation of minor actinides**

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Les données du problème

1 REP de 1000 MWe chargé avec du combustible UOX et qui produit 6 TWhe/an, génère 21 t de combustible irradié

20 t de U avec 0,9 % ^{235}U

200 Kg de Pu

MOX

21 Kg d'Actinides Mineurs
- 10,4 Kg Np
- 9,8 Kg Am
- 0,8 Kg Cm

Verres

760 Kg de produits de fission
- 35 Kg ^{135}Cs + ^{137}Cs
- 18 Kg ^{99}Tc
- 16 Kg ^{99}Zr
- 5 Kg ^{107}Pd
- 3 Kg ^{129}I

etc. ...

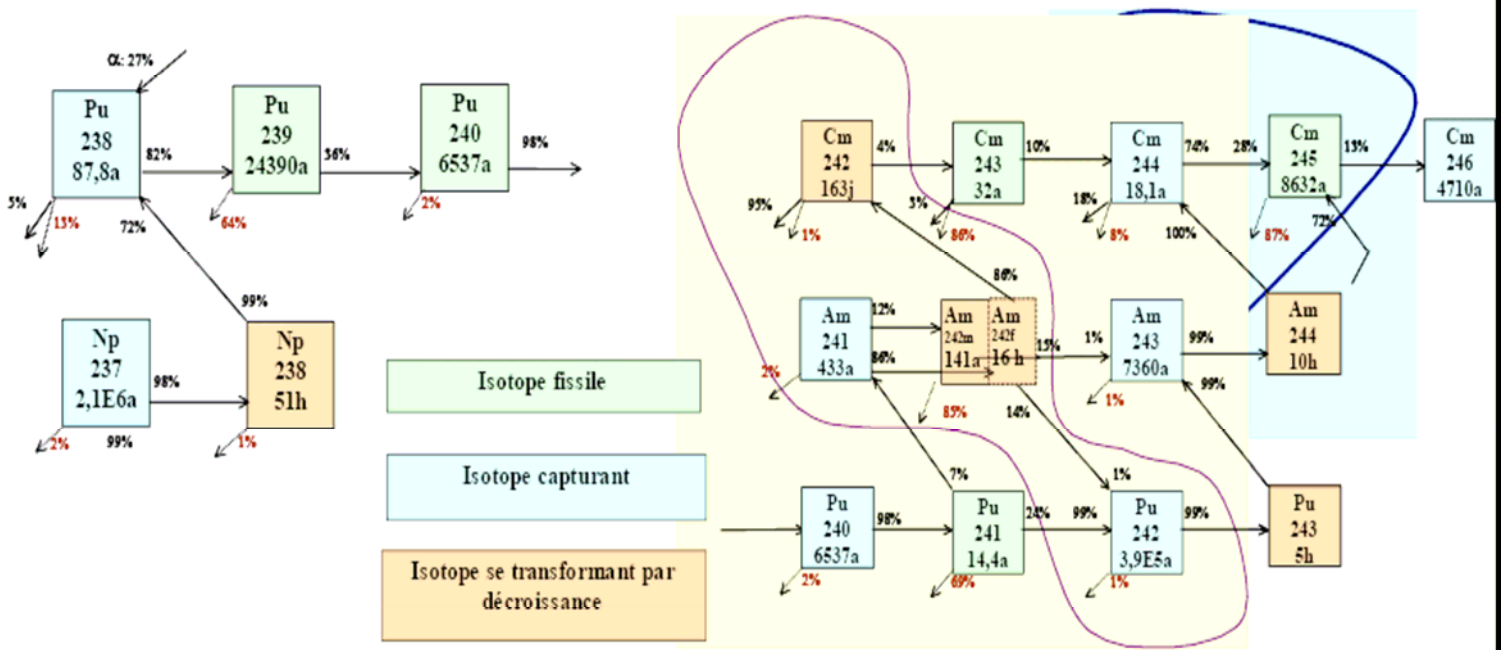
Parc français :
⇒ ~12 t Pu/an ; 1,2 t A.M./an ; 3,5 t PFVL/an

Transmutation : Chaînes d'évolution

Les réactions sous flux neutronique sont complexes et pour obtenir un bilan complet de la transmutation, il faut tenir compte de l'ensemble des interactions sur l'ensemble de la chaîne de filiation et des décroissances naturelles

Deux paramètres sont influents :

- les sections efficaces de l'ensemble des isotopes impliqués
- l'intensité du flux de neutrons



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Experimental programme

GELINA: ^{245}Cm(n,f) cross section with resonance and high energy neutrons

BR1 reactor: ^{243}Cm, ^{245}Cm, ^{247}Cm and ^{248}Cm(n_{th},f) cross sections

HFR of ILL: ^{244}Cm and ^{246}Cm(n_{th},f) cross section (small cr. sect.→ more intense neutron beam needed)